ENDEMIC BUILDING COLLAPSE IN AKWA IBOM STATE: THE CAUSES, EFFECTS AND REMEDIES.

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ABSTRACT

The study examined the endemic building collapse in Akwa Ibom State as well as the causes, effects and remedies. Three specific research objectives were formulated to guide the study. The research design was an Expost Facto type. The population of the study comprised of all architects, civil engineers, quantity surveyors, electrical engineers and teachers of building technology. 200 respondents incorporating the above personnel were randomly selected for the study. The instrument known as "endemic building collapse Questionnaire (EBCQ)" was used to collect data. The instrument was subjected to reliability test, using Crombach Alpha technique method and it produced high reliability coefficient of 0.91 which helped justify the use of the instrument. The findings from the data collection and analysis show various causes of building collapse in Nigeria to include poor concrete mix ratio. The result also proved that there are various effects of building collapse in Nigeria including loss of lives. Finally, the remedies to the prevalent building collapse were identified as factors related to project management, project contractor, design, materials etc. Among others, it was recommended that Uyo Capacity Municipality should be strict in their inspection and approval of the building plans as well as giving effective supervision during the building process.

KEY WORDS: Building collapse, Causes, Effects, Remedies and Nigeria.

INTRODUCTION

Buildings are structures which serve as shelter for man, his properties and activities. They are expected to be properly planned, designed and erected to obtain desired satisfaction from the environment. Collapse in building could be total or partial failure of one or more of its components leading to inability of the building to perform its principal functions of safety and stability. Ikpo (2006) defined building failure as a defect or imperfection, deficiency or fault in building elements or components. It may also be as a result of omission of performance. The degree of building failure can therefore be related to the extent or degree of deviation of a building from the "built" state which in most cases represents the acceptable standard within the neighbourhood, locality, state or country. Building collapse has so often been associated with structural collapes. A structure is a whole building, complex framework or essential part of a building. The structure of the building is that part of building construction which gives the construction sufficient strength to withstand the load to which the whole building is subjected. The structure is that which carries load and transfers the load from the point of load application to the point of load support.

Every structural system is designed to meet some needs and be safe to avoid loss of life, property and damage to the environment. In a normal setup, building collapse are not expected within the projected lifespan of structures, but due to the imperfection in the action of human beings and the existence of so many other external factors that influence the safety of structures, collapes do occur (Ede, 2010). According to Wardhana and Hadipriono (2003), collapse and distress are subsets of failure in a building. In terms of functionality, collapse occurs when the entire or a substantial part of a structure comes down thereby losing the ability to perform its function. Building collapse may be classified as total and partial collapse. Total collapse implies that several primary structural members of a building have fallen down completely while partial collapse suggests a condition where only some of the primary structural members of the building components have fallen down. Though building collapse is not peculiar to Nigeria, the trend in the country is becoming quite worrisome and a source of concern to stakeholders.

According to Ayedun, Durodola and Akinjare (2012), the spate and frequency of occurrence have become a major source of concern not only to the government but to all meaning Nigerians and most especially the stakeholders in the building industry as the magnitude of the incidents are becoming very unprecedented. That building collapse incidence is still regularly occurring despite the fact that there has been the increasing diffusion of engineering knowledge over the years has brought to question whether these stakeholders have critically examined the reasons for building failure and the roles they can play or the strategies they can articulate that would help to arrest the incidents. This seeming gap portend the reason for this article, thus this article examines the determinants of building collapse in Akwa Ibom State with the desire to finding out the causes, problems and the possible ways of arresting the situations.

Statement of the problem

Building failure rate in Nigeria is very alarming and has resulted in the loss of lives, properties and even much financial investment is wasted. Every built structure is expected to satisfy the functional objectives which is safety, serviceability and economy, but instead the menace of building collapse in Nigeria is growing at an alarming rate, seemingly uncontrollable or beyond easy control and this has been a source of serious concern to all stakeholders, the professionals in building industry, government, private developers, clients and users, as well as neighbourhood residents. Building collapse is very dangerous and should be avoided using all necessary precautions and machineries possible. Ultimately, the effect of collapse of building structures, particularly at its completion stage and when it is occupied by users is devastating on human lives. Several productive lives and properties have been lost in the various incidences of building collapse in Akwa Ibom state and these losses which would truly be felt by future generations, have negatively impacted the socio-economic status of its citizens. Improving the qualities of lives in a city is fundamental to cities sustainability and a sustainable city is one that maintains lasting security from environmental hazards that may threaten developmental achievements. This paper therefore aims at assessing the factors responsible for building collapse in Akwa Ibom State, the effects and remedies that could ameliorate the menace of building collapse, (Akwaowo (2019).

Purpose of the Study

The general objective of this study is to examine the determinants of building collapse in Akwa Ibom State. The specific objectives therefore include:

1. To identify factors responsible for building collapse in Akwa Ibom State.
2. To examine the effects of building collapse in Akwa Ibom State.
3. To find out the remedies of building collapsein Akwa Ibom State**.**

Research Questions

The following research questions will be answered:

1. What are the factors responsible for building collapse in Akwa Ibom State?
2. What are the effects of building collapse in Akwa Ibom State?
3. What are the remedies of building collapsein Akwa Ibom State?

Literature Review

Basic Building Requirements

According to Ogunsemi (2002), the basic requirements that a building must satisfy each and every member of a structural system should be able to resist, without failure or collapse, the applied loads under the service conditions. This means that, it must possess adequate strength. It also demands that the materials of the structure must be adequate to resist the stresses generated by the loads, the shape and size of the structure must also be adequate. Also, the components of the structure should be able to resist deformation under loading conditions. Deformation implies a change in size and shape when a body is subjected to stress. This means that the component should possess adequate stiffness. A material or structure that is very strong but lacking in stiffness will so much deform that it will not be able to resist applied loads.

All the structural members of the building must be firm, otherwise the whole structure is assumed to be unstable. Structural stability is needed to maintain shape since it is the ability of a structure to retain under load 002C its original state of equilibrium. It can mean anything from resistance to sliding, overturning, partial or complete collapse. Any phenomenon that can alter the load carrying behaviour of a structure, if not properly taken care of can lead to instability; a condition in which the support reaction is less than applied load. Thus to ensure stability, loads must be balanced by reactions, and the moments due to loads must be balanced by the moments due to reactions. Any building that cannot withstand the load applied up on it will show signs of distress which may lead to failure and invariably total collapse (Ukpata, 2006). Akinpelu (2002), stated that the possibility of building collapse should not be underestimated. Its occurrence is usually accompanied by casualty such as loss of properties and lives. A building may collapse when one or more of its essential components fail. When buildings collapse, professional bodies such as Architects' Registration Council of Nigeria (ARCON),

Council for the Registration of Engineering in Nigeria (COREN), and even Governments usually set up panels of enquiry to determine the immediate and remote causes of such collapse and if possible recommend sanctions against those culpable, (Akwaowo (2019)). The rate of collapsed buildings in Nigeria has been a source of serious concern to professionals, like Architects, Builders, and Structural Engineers. Building collapse has so often been associated with structural failure. Therefore, structural failure, no doubt, are very dangerous and should be avoided using all necessary precautions and machineries possible. Ultimately, the effect of collapse of a building structure, particularly at its completion stage and when it is occupied by users is devastating on human lives. Even if lives are not lost, much financial investment is

wasted. Once the specifications of the building including its materials and components are not complied with during construction, the result is building failure.

Factors Responsible For Building Collapse in Nigeria

Building collapse can be attributed to many factors. Many buildings in Nigeria have collapsed due to some of the following reasons.

i. Adoption of wrong foundation:

It is obvious that foundation plays a predominant roles in the durability of buildings. As stated by Lambe and Whitman (2000) foundation is the part of the structure in direct contact with the ground and which transmits the load of the structure to the ground which plays an important role in the construction of building structures. Foundation is expected to carry all the dead, super-imposed and wind loads from a building to the soil on which the building rests in such a way that settlement of the structure is limited, so that failure of the underlying soil is prevented. The depth of soil strata in response to the loading from the structure has to be located properly in order to safely bear the foundation of the building. This is true in view of the fact that absence of such component of building can cause the structure to collapse and cause loss of lives and properties.

ii. Improper walling:

The wall is a very important part of the building that also provides support. Other function is to enclose or divide space. A wall that will adequately provide support is a load-bearing wall which must provide adequate strength and stability, weather resistance and durability. The commonest walling material in Nigeria now is sandcrete blocks of various sizes. As a matter of fact, walls which provide support to buildings must be straight, perpendicular and produced of sound materials. The appearance of a crack line in a building is a sign of failure. Failure in block-laying may lead to eventual collapse of the building.

iii. Inadequate preliminary works:

The roles played by preliminary works cannot be overemphasized as it contributes to the durability of buildings. Preliminary works are operations which include site investigation and foundation. Building collapse is imminent where these operations are carried out shoddily. Site investigation is to determine the properties of the soil strata. Seeley (2006) said that all potential building sites would need to be investigated to determine their suitability for buildings and the nature and extent of the preliminary work that would be needed. Particular attention should be given to the nature of the soil and its probable load-bearing capacities, as there may be variations over the site. The past history of the site should be investigated with particular reference to the former existence of trees, water level, borehole log, underneath soil strata and waste dumps. A careful study should be made of adjacent structure to ascertain whether failure can result due to localized conditions. According to Bell (2002), soil is an unconsolidated assemblage of soil particles between which voids. These voids may contain water, air or both. Soil is derived from the breakdown of rock materials by weathering and erosion and may have suffered some amount of transportation prior to deposition. Neville and Chatterton (2005) asserted that the development of soil mechanics which relates to the understanding of the physical properties of any particular soil type in relation to loads was really the main stepping stone towards a scientific approach to foundation problem and construction. However strong, rigid or structurally stable a building may be, its satisfactory performance depends exclusively upon the ground which supports it.

Adequate site investigation prevents the issue of foundation problem because it would ensure that the most appropriate foundation is prescribed.

iv. Lack of approved structural design:

Requirement of any structural component of a building is that it should be strong enough to carry and support all possible types of loads to which it is likely to be subjected. Therefore, building design is not just the Architectural design; it also includes structural, electrical and mechanical engineering, (Ataev 2004), A building that is poorly designed structurally will eventually collapse. The final object of structural analysis is to enable the Engineering design and construct a building structure, which is satisfactory in service, and that such design must be approved by the approving body. This means that it must not collapse when loads are applied and the deformation must not be excessive. In addition, some clients, in order to try and save cost, patronize quacks to do designs for them. This is very common in Nigeria and such designs are grossly inadequate and usually result in building failure.

v. Poor concrete mix ratio:

When the materials for concrete are not adequate enough it can contribute to building collapse. As stated by Tomilson (1980) poor materials do not make good concrete. The cement, sand and stone must all be sound and have the types and qualities specified. According to him, the steel reinforcements are embedded in concrete, so that compressive stresses are taken by concrete, while tensile stresses are catered for by steel reinforcements.

vi. Poor building material specification:

The uses of poor building material specifications have been possible root causes of collapse. In buildings, the materials that are essentially used on construction sites are cement, sand, gravel, granite chipping, timber, iron rods and sandcrete blocks. Other materials are aluminium, glass and ceramics. Good building constructions are enhanced by materials of good quality. Proper handling and storage must be given to building materials. Material specifications must relate exactly to the intended construction and must be of adequate standard. Specifications are to prescribe what materials should be used and where there is a deviation, failure, that is, building collapse should be expected.

vii. Ineffective supervision:

Averting building collapse depends largely on effective supervision of works. Hence, improper supervision will lead to the collapse of the building structures. Supervision involves the intricate knowledge of workmanship and materials, while inspection is only to ensure adherence to contract documents, especially the drawings. The object of the supervision is primarily to ensure that employer's requirements as expressed in the contract documents are correctly interpreted and the problems which are bound to arise are satisfactorily resolved. In the case of the building under study, there was no proper supervision for the demolition works.

viii. Climate:

Apart from building collapse arising from negligence or negligent behaviour, many of our buildings, especially mud buildings have collapsed due to persistent incidence of weather while blocked buildings most time collapse in its inception as a result of heavy rain. Ogunsemi (2002) remarked that a good building is not that which merely fulfils the purpose for which it is

designed and erected, but a building comely and able to withstand the onslaught of weather conditions.

Effects of Building Collapse in Nigeria

According to Sodare and Usman (2006), the consequences associated with building collapse cannot be overemphasized in Nigeria and the world at large. These structural collapse (caused by an accidental action) typically come in several forms: for example fatalities, injuries, structural damage, damage to contents, loss of functionality and environmental damage. When considering structural collapes, these consequences are often divided into two categories, direct and indirect consequences. It can be rightly said that any pursuit of human endeavour has its cost, but the cost being paid in the Nigerian building industry cannot be justified. Each collapse carries along with it tremendous effects that cannot be easily forgotten by any of its victims. The consequences are usually in form of economic and social implications. These includes: loss of human lives, injuries, economic waste in terms of loss of properties, investments, jobs, incomes, loss of trust, dignity and exasperation of crises among the stakeholders and environmental disaster (Ede, 2010).

The quantification of the complete effects of any collapse is extremely difficult as there are so many factors involved, and these including emotional and subjective factors. Apart from the number of deaths that can often be truly identified, the rest of the effects are surrounded by so many uncertainties which make the analysis only approximate. Leaving aside the grossly quantifiable economic sums, the stress, trauma and shocks may have some far-reaching effects upon the building owner and/or employees, occupant, and others involved in one way or the other with the structure. The negative impact of such collapes on the social-economic development of our economy is obvious. As many previous lives are lost, the nation loses the contribution that could have come from these victims towards the socio-economic growth of the nation. More so, this increasing rate of death from building collapse in Nigeria runs against the United Nations MDGs (Millennium Development Goals) programmes aimed at reducing the mortality rate and improving safety and life expectancy of the world population. For this, incidence of deaths during the collapse is deeply analysed in the remaining parts of this research work as to proffering solutions towards reducing it. Some of the effects of building collapse include:

Discouragement of Property Development

Persistent collapse has discourage many developers to invest in property development, most especially those who are new in the system. As a result of this, they may move into other investments e.g. stock and shares.

Loss of lives and Properties

Many lives have been lost as a result of building collapse. Property worth millions of Naira has been wasted in Nigeria most especially in Akwa Ibom state due to building collapse. People invest for the purpose of making profit and/or personal uses and when it collapses, it discourage investors for further investment in property. The collapsed property most time cannot be regain except such property has been insured, which most developers hardly do these days.

Scarcity of Property

Continuous collapse of property may lead to scarcity of property in a particular area as the demand for property may go higher. Also as it discourages investors or property developers, the units of dwelling will also reduce, and this will lead to scarcity of property or short falls.

Economic loss

Economic loss is a major consequence of building projects collapse. The result of this menace is immeasurable. The resources sunk into the actualization of such project will lie wasted while the occupants or intending occupants becomes stranded. Meanwhile, the expected return on investment is denied. Moreso, various failed public buildings scattered across the length and breadth of the state is making the environment unhealthy as some of such buildings has become a refuse dump site posing environmental hazard to the neighborhood. Other effects of public building failure include security threat. This is because some of the failed and abandoned projects now serve as habitations for hoodlums, for robbers, touts, etc. thereby posing a great security threat to the society.

Other Consequences include:

- Loss of reputation and integrity leading to psychological trauma
- Loss of new commissions and contracts
- Withdrawal of practicing licenses
- Loss of materials and capital investments: Components and materials are damaged beyond re-use. Capital investments are not recoverable, leading to bankruptcy and high economic implications to the nation's economy.

Prevention and Solutions to Building Collapse in Nigeria

Certain factors exist in order to facilitate the achievement of project objectives which in most cases are referred to as key performance indicators. This factors can also be termed "Critical success factors" (Jha and Iyer 2006).

Factors related to Project Management

Ability to make effective decisions both at the construction stage and utilization state. If this factor must curb the failure of the building project (whether in long term or short term), the project management team must be vast in; planning efforts, previous project management experience, effective monitoring, effective method of planning and scheduling, objective management, appropriate project risk management etc.

Factors related to Project Manager

Experience and capability of project manager; understanding of project's mission; project manager's ability to coordinate and motivate team; technical knowhow of the project manager; project manager's ability to take concrete decision; ability of project manager to avoid scope creep; leadership skills of the project manager.

Factors related to Contractor

Cash flow of the contractor; contractor's experience; management of site; site supervision; detailed and comprehensive design; contractor's ability to manage the design

Factors related to Client

Effective and efficient decision making by client; ability of client to take decision; provision of adequate finance; client's experience

Factors related to Environment

Effect of the economy; technological attainment; support from top management; political risks; constructability; appropriate dispute resolution system; weather conditions; environmental health & safety.

Factors related to Procurement

Effective procurement process in needed to remedy the problem of building collapse. The the procured items must be effectively assessed to be sure that the required prescription has been adhered during the delivery.

Factors related to Design Team

Relationship between team members, effective communication and information management by the design team should be firmed. The design must be given to the professional e.g. the Plan drawing to the Architect, while the structural, electrical and mechanical drawing should be done by the Engineers.

Factors related to Materials: Quality materials should always be used, and must be tested before usage. Cost should not be minimized to get a quality and standard material as it is dangerous to the life of the developers and the property itself, when sub-standard materials are being used.

Methods

Research Design

The research design for this study, as found fit was an Expost Facto type.

Area of the Study

The area of study is Akwa Ibom State.

Population of the Study

The population of the study consisted of all the architects, civil engineers, quantity surveyors, electrical engineers and teachers of building technology and technical education in Akwa Ibom State.

Sample and Sampling Technique

The respondents in the study consisted of 200 architects, civil engineers, quantity surveyors, electrical engineers and teachers of building technology and technical education. They were

obtained through the simple random sampling method. Hence, the sample size of 200 respondents was used for the study.

Research Instrument

The researcher developed one instrument tagged "Determinants, effect and remedies of Building Collapse Questionnaire (DBCQ)". The instrument was made up of two sections, sections A and B. and used for data collection.

Validation of the Research Instrument

The instrument was face and content validated by an expert in test, measurement and evaluation. The corrections and comments were incorporated into the final form of the instrument.

Reliability of the Instrument

Pearson product correlation was used to determine the reliability of the instrument (DBCQ), using 30 respondents who were not part of the main study but possess the character of the population. The reliability co-efficient was 0.84 showing that the instrument is reliable.

Data analysis technique

One research question was answered with descriptive analysis while the hypotheses were tested with chi-square analysis. The results of the statistical analysis for the hypotheses were tested for significance at 0.05 alpha level. Each result was considered significant if the calculated value was either equall to or greater than the critical value, but non-significant if the calculated value was less than the critical value.

RESULTS AND DISCUSSIONS

Research Question

The research question sort to find out the factors responsible for building collapse in Akwa Ibom State. In order to answer the question, percentage analysis was used. (See table 1)

TABLE 1:

Descriptive analysis on the factors responsible for building collapse in Akwa Ibom State

Factors	Freq	Percentage(%)
Adoption of wrong foundation	142	13.48
Improper walling	103	9.77
Inadequate preliminary works	143	13.57
Lack of approved structural design	117	11.10
Poor concrete mix ratio	187	17.74**
Poor building material specification	140	13.28
Ineffective supervision	123	11.67
Climate	99	9.39*
TOTAL	**1054**	**100**

**** Highest percentage frequency**

*** Least percentage frequency**
SOURCE: Field Survey

The above table 1 present the descriptive analysis of the factors responsible for building collapse in Akwa Ibom State. From the result, it was observed that the highest factor responsible for building collapse in Akwa Ibom State was poor concrete mix ratio 187(17.74%), while the least was climate 99(9.39%). The result of the findings was therefore in agreement with the opinion of Tomilson (1980) poor materials do not make good concrete. The cement, sand and stone must all be sound and have the types and qualities specified. According to him, the steel reinforcements are embedded in concrete, so that compressive stresses are taken by concrete, while tensile stresses are catered for by steel reinforcements.

Research Question Two

The research question sort to find out the effects of building collapse in Akwa Ibom State. In order to answer the question, percentage analysis was used. (See table 2)

TABLE 2:

Descriptive analysis on the effects of building collapse in Akwa Ibom State.

Effects	Freq	Percentage(%)
Discouragement of Property Development	67	6.36
Loss of lives and Properties	156	14.81**
Scarcity of Property	32	3.04*
Economic loss	121	11.48
Loss of reputation and integrity	152	14.42
Loss of new commissions and contracts	139	13.19
Withdrawal of practicing licenses	117	11.10
Loss of materials and capital investments	109	10.34
TOTAL	**1054**	**100**

**** Highest percentage frequency**
*** Least percentage frequency**

SOURCE: Field Survey

The above table 2 presents the descriptive analysis of the effects of building collapse in Akwa Ibom State. From the result, it was observed that the highest effects of building collapse in Akwa Ibom State was loss of lives and properties 156(14.81%), while the least was scarcity of property 32(3.04%). The result of the findings was therefore in agreement with the research findings of Ede, (2010), who stated that each collapse carries along with it tremendous effects that cannot be easily forgotten by any of its victims. Also said that the consequences are usually in form of economic and social implications, which includes: loss of human lives, injuries, economic waste in terms of loss of properties, investments, jobs, incomes, loss of trust, dignity and exasperation of crises among the stakeholders and environmental disaster.

Research Question Three

The research question sort to find out the remedies of building collapse in Akwa Ibom State. In order to answer the question, percentage analysis was used. (See table 3)

TABLE 3:

Descriptive analysis on the remedies for building collapse in Akwa Ibom State.

REMEDIES	FRQ	%
Project management team effective planning efforts, previous project management experience, effective monitoring, effective method of planning and scheduling, objective management and appropriate project risk management.	189	17.93**
Project manager understanding of project's mission; ability to coordinate and motivate team; technical knowhow; ability to take concrete decision; ability to avoid scope creep and leadership skills of the project manager.	186	17.65
Consideration of contractor's cash flow, experience; management of site; site supervision; detailed and comprehensive design and ability to manage the design.	76	7.21
Clients' effective and efficient decision making; ability to take decision; provision of adequate finance; client's experience.	87	8.25
As regards environment there should be consideration of technological attainment; support from top management; political risks; constructability; appropriate dispute resolution system; weather conditions and environmental health & safety.	54	5.12*
As regards procurement process, the items purchased must be effectively assessed to be sure that the required prescription has been adhered during the delivery.	167	15.84
As regards the design team, the design must be given to the professional e.g. the Plan drawing to the Architect, while the structural, electrical and mechanical drawing should be done by the Engineers.	176	16.70
Quality materials should always be used, and must be tested before usage.	169	16.03
TOTAL	**1104**	**100**

**** Highest percentage frequency**
*** Least percentage frequency**

SOURCE: Field Survey

The above table 3 presents the descriptive analysis of the remedies of building collapse in Akwa Ibom State. From the result, it was observed that the highest percentage of the respondent

was 189(17.93%) who said the remedies of building collapse in Akwa Ibom State are project management team effective planning efforts, previous project management experience, effective monitoring, effective method of planning and scheduling, objective management and appropriate project risk management, While the least respondent on the list 54(5.12%) the remedies are consideration of technological attainment as regard to the environment; support from top management; political risks; constructability; appropriate dispute resolution system; weather conditions and environmental health & safety. The result of the findings was therefore in agreement with the research findings of Jha and Iyer, (2006), who state that certain factors exist in order to facilitate the achievement of project objectives which in most cases are referred to as key performance indicators. This factor can also be termed "Critical success factors".

Conclusions

Collapse of building does occur in Akwa Ibom State but in rare cases. Collapse of building is majorly caused by poor concrete mix ratio, inadequate preliminary works, adoption of wrong foundation, etc. It was also concluded that building collapse in Akwa Ibom State mostly abrings about loss of lives and properties, reputation and integrity, loss of new commissions and contracts, etc. Finally, building collapse can be minimized or ended with project management team effective planning efforts, previous project management experience, effective monitoring, etc.

Recommendations

1. Uyo Capacity Municipality should be strict in their inspection and approval of the building plans as well as giving effective supervision during the building process.
2. Adequate preliminary works should be done before the real building process is embarked upon.
3. The architects and other regulatory bodies should ensure the builder adoption of make and good foundation, good concrete mix ratio and proper walling.
4. The structural design should be approved before the building exercise occurs.
5. Good building material specification should be strictly adhered to as well as effective supervision given for good and quality delivery.
6. Building should be done most time during the dry season and when it is not raining in order to encourage a firm foundation of the building.

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